

Memo



Date: September 5, 2007
To: Kevin Stewart and Chad Kudym
From: Markus Ritsch
Subject: August 2007 ALERT Data Analysis

I. ALERT Data Source

Raw ALERT data records extracted from the Urban Drainage and Flood Control District's Nova Star 4.0 base station (ALERT 2) were analyzed for the period August 1 through August 31, 2007.

II. General System Analysis Summary

A total of 260,965 individual data records were analyzed. Meteorological sensors account for 55 percent, water level sensors 14 percent, and rain sensors 6 percent of the total monthly transmissions.

Ninety-nine percent of the received data reports were flagged as "good" by the Nova Star validation process. Roughly 639 reports were flagged as "bad". Of these "bad" reports, 39 originated from Louisville Lake (ID 4744), 33 originated from Salisbury Park (ID 2724) and 28 originated from Boulder Creek at Broadway (ID 4583).

The system-wide radio traffic loading this month was 8,155 reports per day with an average hourly loading of 340 reports. The peak hourly traffic loading was 1,080 reports, which occurred on August 5th between 6:00 PM and 7:00 PM. A plot of monthly average and peak hourly traffic loading is provided.

A total of 2,402 reports were received from the Hayman gages this month.

The sensors reporting most frequently this month include:

1. Elbert (ID 1441 - relative humidity) with 4,915 reports,
2. Stapleton (ID 1461 - relative humidity) with 3,622 reports,
3. Boulder Creek at Broadway (ID 4583 - water level PT) with 2,899 reports.

The reports from the above sensors are distributed evenly throughout the month.

The sensors reporting infrequently this month include:

1. Utah Park (ID 435 - battery) with 1 report,
2. Harvard G. Pk/Pre90 (ID 903 - water level PT) with 3 reports,
3. Harvard Gulch Park (ID 603 - water level PT) with 25 reports, and
4. Englewood Dam (ID 1605 - battery) with 29 reports.

III. Rain Sensor Timer Reporting Summary

The following analysis assumes that each rain sensor has a 12-hour timer reporting interval. System-wide the ALERT 2 base station received approximately 90 percent of the non-incrementing timer reports. The 5 worst-performing rain sensors for the month are summarized (Table 1).

Table 1. Monthly Summary of Sensors with Poor Timer Performance (Sensor ID)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
750	1330	2310	1810	1810	1810	1810	1600				
4470	1460	1710	540	310	1710	4560	410				
4560	2330	2350	310	540	4470	2350	1350				
4240	4170	2240	850	850	1500	2250	2190				
4510	4470	2250	1710	1710	4290	4200	4820				
				900	540	4240	4830				

Sensors identified as having poor timer performance in multiple months are shaded with unique colors. A developing trend can thus be identified from the color shading as the year progresses.

Sensor ID 1460 has a 24-hour timer reporting interval and is not included in the timer reporting analysis.

Sensor ID 1810 has an 18-hour timer reporting interval and is not included in the timer reporting analysis after the month of July.

IV. Rain Sensor Event Reporting Summary

A. District-Wide Total Tip/Count Statistics

The incrementing reports from all 1-mm rain sensors (excluding Hayman sensors) that reported for the entire month were analyzed to quantify the District-wide statistical total monthly tip summary (Table 2).

Table 2. District-Wide Total Tip/Count Statistical Summary

Statistical Parameter	Value	Comments
Mean	46.38	Only the 1-mm rain sensors were included in the analysis
Median	45	Only the 1-mm rain sensors were included in the analysis
Standard deviation	18.77	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	102.68	
Minimum total count	2	Logan Mill (ID 4140)
Maximum total count	125	Hiwan G.C. (ID 2210)

A monthly summary of the District-wide mean total tip/count is presented (Table 3).

Table 3. Monthly Summary of District-Wide Mean Total 1-mm Tip/Count

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
2006	4.62	5.92	18.39	20.47	19.44	13.75	74.03	46.89	24.17	41.13	5.04	16.45	24.19
2007	11.56	5.40	29.75	65.03	68.30	15.87	36.20	46.38					

The average precipitation experienced district-wide in August was increased from the previous months of July and June. The District-wide precipitation experienced in July of 2007 was almost exactly that experienced in the same month in 2006.

The rain sensor with the lowest tip count total for the month was Logan Mill (ID 4140).

The rain sensor with the highest tip count total for the month was Hiwan G.C. (ID 2210). There was a problem with the military connector at this station that was fixed by OneRain on August 6, 2007.

There were no sensors that experienced a total tip count of more than the system-wide mean plus 3 standard deviations.

B. Sensors with a Jump of Six or More in the Sequential Count

Fifty seven (57) rain sensors experienced a jump in their sequential tip count of more than six. The tip count series for these sensors was manually inspected and summarized below.

Table 4. Sensors with Large Jump in Count on 8/24/2007

Watershed	Sensor ID	Count 1	Count 2	Jump	Date/Time
Ralston Creek	100	299	306	7	8/24/07 10:52:06 PM
Ralston Creek	120	262	269	7	8/24/07 1:54:38 PM
Ralston Creek	150	82	93	11	8/18/07 12:48:50 AM
Ralston Creek	200	238	247	9	8/24/07 12:54:06 PM
Ralston Creek	210	222	230	8	8/24/07 3:25:54 PM
Ralston Creek	220	275	283	8	8/24/07 11:07:02 PM
Ralston Creek	300	227	235	8	8/24/07 11:19:07 PM
Ralston Creek	310	262	271	9	8/24/07 12:38:48 PM
Ralston Creek	330	81	91	10	8/24/07 1:36:24 PM
Westerly Creek	400	285	305	20	8/24/07 4:45:16 PM
Westerly Creek	420	393	413	20	8/24/07 4:02:53 PM
Westerly Creek	500	336	356	20	8/24/07 2:49:00 PM
Westerly Creek	510	306	329	23	8/24/07 10:21:05 AM
Westerly Creek	520	279	296	17	8/24/07 11:48:46 PM
Westerly Creek	530	246	259	13	8/24/07 11:48:57 PM
Westerly Creek	540	264	287	23	8/24/07 4:01:39 PM
Gold Smith/Harvard Creek	600	252	259	7	8/24/07 1:32:17 PM
Gold Smith/Harvard Creek	610	275	290	15	8/24/07 11:46:59 AM
Gold Smith/Harvard Creek	630	509	517	8	8/24/07 11:53:45 AM
Gold Smith/Harvard Creek	640	293	301	8	8/24/07 9:17:16 PM
Gold Smith/Harvard Creek	650	287	303	16	8/24/07 6:55:48 PM
Upper Sand/Toll Gate Creek	700	460	482	22	8/24/07 11:59:39 PM
Upper Sand/Toll Gate Creek	720	245	263	18	8/24/07 12:55:26 AM
Upper Sand/Toll Gate Creek	800	248	268	20	8/24/07 10:17:33 AM
Upper Sand/Toll Gate Creek	820	256	263	7	8/24/07 1:56:27 AM
Upper Sand/Toll Gate Creek	830	321	328	7	8/24/07 2:04:24 AM
Upper Sand/Toll Gate Creek	840	153	173	20	8/24/07 6:41:23 PM
Upper Sand/Toll Gate Creek	850	1	20	19	8/24/07 3:18:34 PM
Upper Sand/Toll Gate Creek	860	298	322	24	8/24/07 5:38:40 PM
Lena Gulch	1000	246	258	12	8/24/07 12:39:27 AM
Lena Gulch	1010	279	298	19	8/24/07 11:09:31 AM
Lena Gulch	1040	270	289	19	8/24/07 8:22:15 PM
Lena Gulch	1050	197	214	17	8/24/07 2:54:06 PM
Lena Gulch	1060	241	263	22	8/24/07 1:02:13 PM
Denver Urban Region	1300	190	201	11	8/24/07 6:07:32 PM
Denver Urban Region	1310	259	271	12	8/24/07 3:24:23 PM
Denver Urban Region	1320	253	266	13	8/24/07 6:19:09 PM
Denver Urban Region	1330	1328	1344	16	8/24/07 8:18:56 PM
Denver Urban Region	1340	1495	1503	8	8/24/07 6:45:55 PM
Denver Urban Region	1350	1661	1671	10	8/24/07 3:12:27 PM
Denver Urban Region	1360	1718	1732	14	8/24/07 8:41:21 PM
Denver Urban Region	1370	1332	1340	8	8/24/07 5:03:42 PM
Denver Urban Region	1400	251	262	11	8/24/07 10:49:18 AM
Denver Urban Region	1420	447	463	16	8/24/07 1:24:29 PM
Denver Urban Region	1460	592	612	20	8/24/07 11:46:12 PM
Denver Urban Region	1480	250	266	16	8/25/07 1:01:52 AM
Denver Urban Region	1660	75	87	12	8/24/07 2:46:58 AM
Denver Urban Region	1700	1519	1530	11	8/24/07 2:01:25 PM
Denver Urban Region	1710	267	274	7	8/24/07 4:32:39 PM
Denver Urban Region	1720	66	82	16	8/24/07 9:39:30 PM
Denver Urban Region	1800	239	258	19	8/24/07 12:03:49 AM
Denver Urban Region	1810	259	276	17	8/24/07 2:25:37 AM
Denver Urban Region	1920	169	185	16	8/24/07 10:18:54 PM
Denver Urban Region	2310	73	92	19	8/24/07 8:11:52 PM
Denver Urban Region	2320	868	885	17	8/24/07 12:52:57 PM
Denver Urban Region	2370	59	66	7	8/24/07 1:11:19 PM
Denver Urban Region	2710	1287	1297	10	8/24/07 11:24:01 AM

The large jump in sequential count value experienced by the 57 sensors occurred between August 23 and August 24, 2007. During this period, the Blue Mountain repeater was down due to a nearby lightning strike. The outage of the Blue Mountain repeater is the cause of the jump in sequential count.

C. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm, tip reports for the month was approximately 80 percent. A total of 6,356 incrementing reports were received and a total of 7,880 were expected. The total loss of incrementing reports for the month was approximately 20 percent. Those sensors with the worst rain event transmission performance characteristics are summarized (Table 5).

Table 5. Monthly Summary of Sensors with the Most Missed Tips

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug*	Sep	Oct	Nov	Dec
2320	1330	540	1350	860	1710	2370	1350				
2190	4080	310	310	4710	1350	150	2310				
4710	1640	4470	1100	1810	310	1700	540				
4090	4050	850	860	1350	1700	1350	1300				
4820	4180	4570	540	400	210	850	1920				
				4570	110	2340	840				

* Note that the outage of the Blue Mountain repeater caused a large data gap in the sequential count series for many sensors and thus the incrementing tip report performance statistics are skewed this month.

Sensors identified as having poor event performance in multiple months are shaded with unique colors. A developing trend can thus be identified from the color shading as the year progresses.

a. Chatfield COE (ID 1350)

The large jump in sequential count experienced by this sensor was due to the repeater outage between August 23 and August 24, 2007.

b. Genesee Village (ID 2310)

A large jump in sequential count was experienced by this sensor during the repeater outage between August 23 and August 24, 2007.

c. Parker/Mississippi (ID 540)

A large jump in sequential count was experienced by this sensor during the repeater outage between August 23 and August 24, 2007.

d. Hidden Lake (ID 1300)

A large jump in sequential count was experienced by this sensor during the repeater outage between August 23 and August 24, 2007.

e. Brighton (ID 1920)

A large jump in sequential count was experienced by this sensor during the repeater outage between August 23 and August 24, 2007.

f. Fire Station 12 (ID 840)

A large jump in sequential count was experienced by this sensor during the repeater outage between August 23 and August 24, 2007.

V. Heavy Radio Traffic Analysis

Periods exceeding 600 messages per hour are analyzed independently in an attempt to identify rain gage sequences where 3 or more, sequential messages were lost.

A. August 5, 2007

The heaviest radio traffic for the month occurred in the evening of August 5th, between 6:00 PM and 7:00 PM.

The distribution of hourly reports for the period is as follows:

- 8/5/2007 from 4:00 pm to 5:00 pm (375 reports)
- 8/5/2007 from 5:00 pm to 6:00 pm (535 reports)
- 8/5/2007 from 6:00 pm to 7:00 pm (1,080 reports)
- 8/5/2007 from 7:00 pm to 8:00 pm (708 reports)
- 8/5/2007 from 8:00 pm to 9:00 pm (502 reports)
- 8/5/2007 from 9:00 pm to 10:00 pm (414 reports)

The peak hour of traffic occurred from 6:00 PM to 7:00 PM when 1,080 reports were received. The period of heaviest traffic was generally a period from 5:00 PM to 9:00 PM. The ALERT data for this period was examined more closely to characterize the distribution of sensor traffic (Table 6). During this time the radio traffic was dominated by rain and water level reports.

Table 6. Peak Traffic Period Sensor Report Distribution

Sensor Group	Reports	Percentage
Water Level PT-HSE	1037	37%
Precipitation	539	19%
None-ALERT-ID	274	10%
Relative Humidity	213	8%
Wind Gust	176	6%
Temperature	155	5%
Wind Speed Average & Azimuth	85	3%
Water Level Float	75	3%
Wind Direction	70	2%
Wind Speed Average	57	2%
Water Level PT	32	1%
Hayman Precipitation	23	1%
Battery Voltage HSE	21	1%
Solar Radiation	16	1%
Battery Voltage Digital	13	0%
Barometric Pressure	9	0%
Battery Voltage Analog	6	0%
Fuel Moisture	4	0%
Fuel Temperature	4	0%
Soil Moisture	4	0%
Precipitation - Mean	3	0%
Handar 585 ALARM Status	2	0%
Repeater Pass List	2	0%
Repeater Status Report	2	0%
Battery	1	0%
Precipitation - Test	1	0%
Total	2824	100%

Incrementing rain records from the 1-mm gages for the heavy radio traffic period were examined to characterize the loss of sequential incrementing tip transmissions (Table 7).

Table 7. Peak Traffic Analysis - Loss of Incrementing Tip Reports

Heavy Traffic Period (Aug 5, 2007)	Occurrences of loss of sequential tip reports during period			
	Loss of 2 tips	Loss of 3 tips	Loss of 4 tips	Loss of 5 tips
5:00 pm to 9:00 pm	15	3	0	1

Lost rain reports are evident during the heavy rain period. The majority of lost reports include single and double tip reports. The loss of 3 or more sequential tip reports was observed three times and there was one occurrence of the loss of 5 sequential reports. These occurrences are examined further.

Table 8. Loss of Incrementing Tip Reports

Mission Viejo Park (ID 760)		Fire Sta 12 (ID 840)		Shop Creek (ID 1710)		Sand Crk Park (ID 1800)	
Date/Time	Tip	Date/Time	Tip	Date/Time	Tip	Date/Time	Tip
8/5/07 5:56:57 PM	255	8/5/07 6:21:13 PM	123	8/5/07 6:04:09 PM	240	8/5/07 5:32:48 PM	212
8/5/07 5:58:00 PM	256	8/5/07 6:26:19 PM	124	8/5/07 6:06:09 PM	241	8/5/07 6:25:58 PM	214
8/5/07 5:59:18 PM	257	8/5/07 6:32:39 PM	125	8/5/07 6:10:29 PM	243	8/5/07 6:27:06 PM	215
8/5/07 6:00:51 PM	258	8/5/07 6:54:56 PM	129	8/5/07 6:13:09 PM	244	8/5/07 6:28:31 PM	216
8/5/07 6:02:15 PM	259	8/5/07 6:56:37 PM	130	8/5/07 6:20:19 PM	248	8/5/07 6:58:37 PM	222
8/5/07 6:04:59 PM	263	8/5/07 6:57:32 PM	131	8/5/07 6:22:19 PM	251	8/5/07 7:33:14 PM	223
8/5/07 6:05:28 PM	264	8/5/07 6:58:19 PM	132	8/5/07 6:40:49 PM	253	8/5/07 5:32:48 PM	212

The loss of 3 or more sequential data reports forms a limit of data degradation that causes a serious problem in the evaluation of alarm threshold conditions to support the flood mitigation needs of emergency responders within the District. The loss of sequential reports is a problem at stream sensors because it could cause the delay in triggering critical alarm conditions.

VI. Unknown Device Analysis – Received Data Log

The ALERT IDs present in the audio signal received by the decoder are compared against a list of “active” device IDs that are defined within NovaStar. Those IDs received by the decoder that are not defined within NovaStar are considered to be “unknown” and may be the result of radio noise or problems with the telemetry system. The reception of “unknown” device reports for the month is summarized (Table 9).

Table 9. Summary of Unknown IDs

Description	Quantity
Total number of unknown IDs (IDs without a device definition)	175
Total reports from unknown IDs	373
Unknown IDs with only a single received report (potential noise)	133
Total reports from all IDs – RecData Log entire month	216,893
Unknown reports as a fraction of total reports	0.17%

The total number of reports from unknown sensor IDs is small relative to the total reports received for the month.

A number of “unknown” sensors had multiple reports which may indicate the existence of a transmitter that is sending information on an ID that is not currently defined within NovaStar. The unknown IDs with multiple reports including the number of reports received by each are quantified (Table 10).

Table 10. Reports Received by Unknown IDs

Unknown Sensor ID	Number of Reports
2239	62
4013	56
1470	14
4094	7
4091	6
1177	6

Unknown Sensor ID	Number of Reports
4829	5
4047	5
4063	5
4093	4
2748	4
1502	3
1427	3

The “unknown” device reports were analyzed temporally to understand when they were received during the day (Table 11). The goal of this analysis is to determine a pattern of occurrence that may correspond to a source of noise in the system, such as the use of a wireless microphone nearby.

Table 11. Temporal Distribution of Unknown Reports

Hour (AM)	Reports	Hour (PM)	Reports
0:00-00:59	14	12:00-12:59	21
1:00-1:59	18	1:00-1:59	9
2:00-2:59	27	2:00-2:59	24
3:00-3:59	25	3:00-3:59	20
4:00-4:59	8	4:00-4:59	19
5:00-5:59	4	5:00-5:59	9
6:00-6:59	6	6:00-6:59	13
7:00-7:59	5	7:00-7:59	7
8:00-8:59	2	8:00-8:59	14
9:00-9:59	9	9:00-9:59	12
10:00-10:59	5	10:00-10:59	14
11:00-11:59	44	11:00-11:59	44

Unknown reports were received during each hour and their distribution throughout the day is shown (Figure 1).

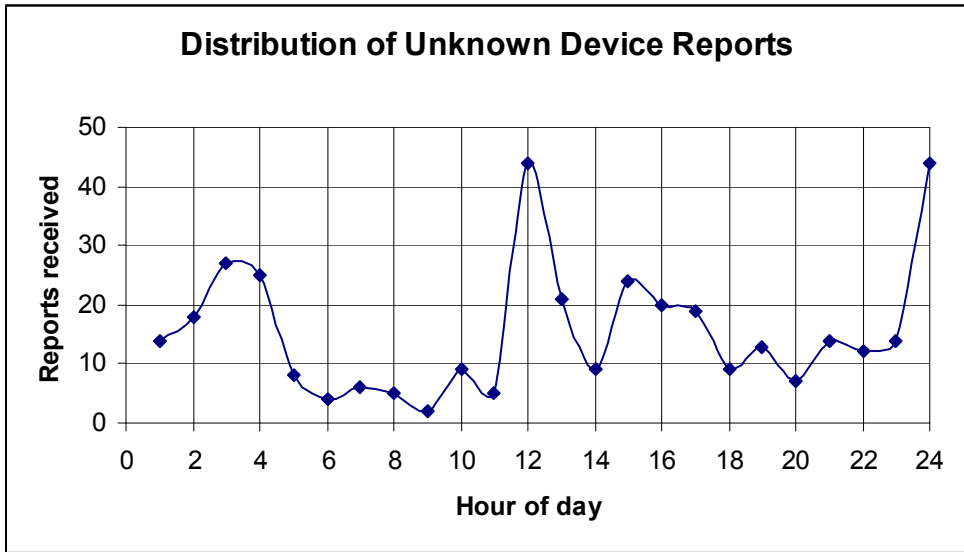


Figure 1. Daily Distribution of Unknown Device Reports

The reception of unknown device IDs peaks at 12:00 noon and at midnight. The afternoon period also seems to receive more unknown IDs than does the morning.

VII. Issues Continued from Previous Month

The following issues were identified last month.

1. **Sand Cr at Mouth (ID 1810), Parker/Mississippi (ID 540), Shop Creek (ID 1710) and Little Narrows (ID 4470):** These sensors all had poor timer performance for the past several months.
2. **Shop Creek (1710), Chatfield COE (1350), Guy Hill Ranch (310), Cherry Creek at Champa (1700), Leyden Confluence (210), Ralston Reservoir (110):** These sensors all exhibited poor event performance for the past several months.
3. **El Ranch (ID 2340):** This sensor exhibited a large number of “bad” or invalid data reports for the month. It is also a sensor with lower than average timer and event reporting statistics.

VIII. Issues Identified this Month

Sensors reporting frequently:

1. **Elbert (ID 1441)** – this relative humidity sensor generated 4,915 reports
2. **Stapleton (ID 1461)** – this relative humidity generated 3,622 reports (*why are these RH sensors reporting so frequently?*)
3. **Boulder Creek at Broadway (ID 4583)** – this water level sensor generated 2,899 reports (*Talked with Dave Pruett about this station. Dave had to run this sensor through a number of calibration cycles with the radio antenna connected and the excessive reporting is attributable to the calibration effort.*)

Sensors reporting infrequently (under reporting):

4. **Utah Park (ID 435)** – this battery sensor had only 1 report (*this may not be an active sensor, just a single corrupt transmission on ID 435*)
5. **Harvard G. Pk/Pre90 (ID 903)** – this water level sensor had only 3 reports (*this sensor has not reported since April of 2006, why did it start reporting in August of 2007?*)
6. **Harvard Gulch Park (ID 603)** – this water level sensor had 25 reports for the month
7. **Englewood Dam (ID 1605)** – this battery sensor had only 29 reports and the reception of reports from this sensor is very poor after 8/15/2007

Poor timer reporting:

8. **Englewood Dam (ID 1600)** – Received only 25 timer reports for the month. Data was not received for this station after 8/15/2007 (*Talked with Dave Pruett who is aware of this problem. Dave thought it may be an issue with the repeater blocking this ID.*)
9. **Kelly Dam (ID 410)** – Received only 40 timer reports for the month. Data was not received for this station after 8/24/2007.
10. **Chatfield COE (ID 1350)** – Received only 41 timer reports for the month. This station did report for the entire month. Poor timer performance may be indicative of deteriorating radio output or poor radio path.

Low rain total:

11. **Logan Mill (ID 4140)** – This sensor recorded only 2 tips for the month when surrounding Boulder Creek stations recorded on average 35 tips.

High rain total:

12. **Hiwan G.C. (ID 2210)** – This sensor transmitted excessive, erroneous rainfall due to corrosion on a pin on the military connector. *The problem was identified and fixed by Dave Pruett on August 6, 2007.*

Large Jump in Sequential Count Value:

13. A total of 57 rain sensors experienced a jump of more than 6 in their sequential count series between August 23 and August 24. OneRain confirmed that a lightning strike took a central repeater (Blue Mountain) out of service during this period. OneRain replaced the repeater on August 24 at which time normal rain transmissions were again received at the base station. The outage of the Blue Mountain repeater explains the large data gap for these sensors.

Invalid Data:

14. **Toll Gate @ 6th (ID 703):** The data series for this sensor shows a reading that was invalidated by the NovaStar base station. The data point looks reasonable. The data validation parameters being used on the NovaStar base station application should be confirmed and adjusted if necessary.

Table 12. Toll Gate @ 6th Data Series

Date/Time	Sensor ID	Count	Data Type	Comment
8/5/2007 6:29:39 PM	703	412	0	
8/5/2007 6:32:39 PM	703	458	0	
8/5/2007 6:38:39 PM	703	556	1	This data value looks reasonable, yet it was invalidated by NovaStar
8/5/2007 6:47:39 PM	703	700	0	
8/5/2007 6:56:41 PM	703	741	0	
8/5/2007 6:59:39 PM	703	753	0	
8/5/2007 7:02:39 PM	703	769	0	

15. **El Ranch (ID 2340):** This sensor continues to exhibit a large number of “corrupt” or invalid data reports.

Reports from “Unknown Sensors”

16. The following table shows the “unknown” sensor IDs and the total number of reports received during the month. These reports indicate the existence of a transmitter that is sending information on an ID that is not currently defined within NovaStar.

Unknown Sensor ID	Number of Reports
2239	62
4013	56
1470	14
4094	7
4091	6
1177	6
4829	5
4047	5
4063	5
4093	4
2748	4
1502	3
1427	3

General System Analysis

Database Name

P:\A207-UDFCD-Data-Analysis\2007_Aug\Novastar_extract_2007Aug.mdb

First Date in Database

8/1/07 12:00 AM

Total Days

31.0

Last Date in Database

9/1/07 12:00 AM

Total Hours

744.0

Total Records Analyzed

260965

Records by Group

None-ALERT-ID	47427	18%
Relative Humidity	35702	14%
Wind Gust	33730	13%
Temperature	30133	12%
Water Level PT-HSE	28290	11%
Precipitation	15349	6%
Wind Speed Average & Azimuth	14976	6%
Wind Direction	13668	5%
Wind Speed Average	10004	4%
Battery Voltage HSE	6338	2%
Water Level PT	4294	2%
Battery Voltage Digital	3115	1%
Solar Radiation	2820	1%
Water Level Float	2809	1%
Hayman Precipitation	2402	1%
Precipitation - Mean	2226	1%
Barometric Pressure	1846	1%
Fuel Moisture	1175	0%
Fuel Temperature	1152	0%
Handar 585 ALARM Status	872	0%
Battery Voltage Analog	712	0%
Repeater Pass List	565	0%
Repeater Status Report	484	0%
12Hr Status Report	231	0%
Precipitation - Test	183	0%
Longmont Flow Gage	121	0%
Battery	119	0%
Soil Moisture	78	0%
Longmont Water Level PT	57	0%
Solar Power	7	0%
Total	260885	

Records by Major Group

Meteorologic Sensors	142879	55%
Water Level Sensors	35571	14%
Rain Sensors	15349	6%
Sensor Status Transmissions	12324	5%
Soil and Fuel Sensors	2405	1%
Total	208528	

Records by Validation Type

Good	0	260326	99.8%
Questionable	1	639	0.2%
Total		260965	

Sensors With Most Invalid Data

Description	Sensor	Reports
Louisville Lake	4744	39
Salisbury Park	2724	33
Boulder Cr at Broadway	4583	28
Castle Rock	2744	26
Highlands Ranch WTP	2704	24

Traffic Loading Summary

Alert Reports	260965	
Average Daily Traffic	8155	
Average Hourly Traffic	340	
Median Hourly Traffic	340	hour beginning
Peak Hourly Traffic	1080	8/5/07 6:00 PM

Rain Timer Performance

Analyze Rain Sensors

systemwide average (days)
0.5211

86%

Rain Sensors	Description	Rcvd	Interval	Expected	Performance
100	Carr Street	54	12:49	64.00	84%
110	Ralston Reservoir	51	12:17	64.00	80%
120	West Woods	57	12:30	64.00	89%
140	Blue Mountain	55	10:44	64.00	86%
150	Nott Creek	49	12:21	64.00	77%
200	Leyden Reservoir	57	12:16	64.00	89%
210	Leyden Confluence	57	12:13	64.00	89%
220	Upper Leyden	57	12:34	64.00	89%
300	Van Bibber Park	56	12:32	64.00	88%
310	Guy Hill Ranch	55	12:31	64.00	86%
320	Sports Complex	59	12:29	64.00	92%
330	Van Bibber @ Hwy 93	54	12:17	64.00	84%
400	Montview Park	55	12:30	64.00	86%
410	Kelly Dam	40	13:05	64.00	63%
420	Expo Park	55	11:57	64.00	86%
440	Fire Station #7	55	12:31	64.00	86%
500	Havana Park	57	11:57	64.00	89%
510	Virginia Court	55	12:19	64.00	86%
520	Jewell Detention	58	11:57	64.00	91%
530	Fire Station #19	58	12:13	64.00	91%
540	Parker/Mississippi	55	13:02	64.00	86%
600	Harvard Gulch Park	61	11:30	64.00	95%
610	Harvard @ Jackson	60	11:57	64.00	94%
620	Quincy/Highline	56	12:48	64.00	88%
630	Temple Pond at DTC	53	13:11	64.00	83%
640	Goldsmith @ Eastman	58	11:57	64.00	91%
650	Iliff Pond	57	12:12	64.00	89%
700	Toll Gate @ 6th	51	13:56	64.00	80%
710	Horseshoe Park Drop	60	12:13	64.00	94%
720	Confluence Pond	57	12:36	64.00	89%
730	No Name @ Quincy	56	12:48	64.00	88%
740	Smoky Hill	59	12:15	64.00	92%
750	Quincy Reservoir	59	12:00	64.00	92%
760	Mission Viejo Park	57	12:15	64.00	89%
800	Sable Ditch @ 18th	55	12:50	64.00	86%
810	Granby Ditch @ 6th	56	12:30	64.00	88%
820	ETG @ Buckley	56	13:04	64.00	88%
830	Side Creek Park	56	12:14	64.00	88%
840	Fire Station 12	57	12:00	64.00	89%
850	Flying J	57	12:15	64.00	89%
860	Sand Cr at Colfax	104	6:48	64.00	163%
870	Murphy Creek GC	55	12:49	64.00	86%
900	Aurora Reservoir	60	11:18	64.00	94%
1000	Maple Grove Resv.	54	13:25	64.00	84%
1010	Denver West	57	12:30	64.00	89%
1020	Lena @ Nolte Pond	59	12:12	64.00	92%
1030	NREL/S. Table Mtn.	55	12:32	64.00	86%
1040	Lena @ U.S. Hwy 6	56	11:57	64.00	88%
1050	Jeffco Fairgrounds	52	13:09	64.00	81%
1060	Heritage Square	57	12:14	64.00	89%
1100	Louisville Rec Ctr	53	12:33	64.00	83%
1110	Gunbarrel	60	12:14	64.00	94%
1200	Broomfield 3207	49	13:48	64.00	77%
1300	Hidden Lake	56	12:40	64.00	88%
1310	LDC at 64th	53	12:14	64.00	83%
1320	SPR at 3rd Ave	56	12:31	64.00	88%
1330	Roslyn	50	12:38	64.00	78%
1340	Sanderson at Xavier	59	12:00	64.00	92%
1350	Chatfield COE	41	15:38	64.00	64%
1360	Denver Zoo	57	12:00	64.00	89%
1370	West Metro FS13	52	13:20	64.00	81%
1400	Upper Sloan Det.	56	12:45	64.00	88%
1420	Diamond Hill	54	12:35	64.00	84%
1440	Elbert	56	11:51	64.00	88%
1460	Stapleton	29	1:29	64.00	100%
1480	Third Creek at DIA	58	11:26	64.00	91%
1500	Powers Park	56	13:02	64.00	88%
1520	Marston Lake North	51	13:12	64.00	80%
1530	Bear Creek @ Lowell	54	12:31	64.00	84%
1540	Sanderson at Xavier	57	12:14	64.00	89%
1600	Englewood Dam	25	13:13	64.00	39%
1610	Holly Dam	59	12:22	64.00	92%
1620	Slaughterhouse Glich	54	12:32	64.00	84%
1640	SPR at Union Ave.	58	12:14	64.00	91%

1660	SPR at Henderson	55	12:11	64.00	86%
1700	Cherry Cr @ Champa	56	12:32	64.00	88%
1710	Shop Creek	50	12:18	64.00	78%
1720	Cherry Cr @ Steele	50	13:37	64.00	78%
1800	Sand Creek Park	55	11:51	64.00	86%
1810	Sand Creek at mouth	38	18:00	64.00	100%
1900	Niver Detention	58	11:57	64.00	91%
1920	Brighton	58	12:15	64.00	91%
2190	Squaw Mountain	43	12:49	64.00	67%
2210	Hiwan G.C.	56	11:59	64.00	88%
2220	Evergreen Lake	60	12:10	64.00	94%
2230	Bear Cr below Cub	56	12:36	64.00	88%
2240	Cold Sprg Gich conf	59	12:17	64.00	92%
2250	Rosedale	58	12:00	64.00	91%
2260	Brook Forest	59	12:00	64.00	92%
2270	Cub Cr below Blue	58	12:00	64.00	91%
2280	Kinney Peak	53	12:18	64.00	83%
2310	Genesee Village	51	13:12	64.00	80%
2330	Morrison	57	11:57	64.00	89%
2340	El Rancho	46	14:04	64.00	72%
2350	Idledale	47	14:28	64.00	73%
2360	Indian Hills	56	12:00	64.00	88%
2370	Red Rocks Park	49	13:01	64.00	77%
2710	Highlands Ranch WTP	58	12:00	64.00	91%
2730	Salisbury Park	58	12:00	64.00	91%
2750	Castle Rock	59	12:00	64.00	92%
2810	Pine Cliff Road	56	12:14	64.00	88%
2820	Haskins Gulch Conf	55	12:53	64.00	86%
2840	Sulphur Gulch	53	12:33	64.00	83%
4010	Crescent	53	12:54	64.00	83%
4020	Rio Grande	58	12:29	64.00	91%
4030	Red Garden	57	12:31	64.00	89%
4040	Martin Gulch	59	11:58	64.00	92%
4050	Walker Ranch	57	12:30	64.00	89%
4060	Lakeshore	56	12:31	64.00	88%
4070	Bear Peak	58	12:31	64.00	91%
4080	Twin Sisters	56	12:47	64.00	88%
4090	Magnolia	48	14:48	64.00	75%
4100	Filter Plant	54	12:33	64.00	84%
4110	Betasso	50	13:11	64.00	78%
4130	Swiss Peaks	51	11:59	64.00	80%
4140	Logan Mill	54	13:08	64.00	84%
4150	Gold Hill	51	12:16	64.00	80%
4160	Sunshine	58	12:30	64.00	91%
4170	Pine Brook	53	13:40	64.00	83%
4180	Gold Lake	57	12:15	64.00	89%
4190	Slaughterhouse	57	12:14	64.00	89%
4200	Lazy Acres	46	14:49	64.00	72%
4220	Fling's	56	12:53	64.00	88%
4230	Golden Age	58	12:29	64.00	91%
4240	Sunset	54	12:31	64.00	84%
4250	Geer Canyon	57	12:27	64.00	89%
4260	Taylor Mountain	60	12:12	64.00	94%
4270	Cannon Mountain	59	11:57	64.00	92%
4290	Red Hill	56	12:44	64.00	88%
4300	Big Elk Park	57	12:13	64.00	89%
4310	Johnny Park	59	12:30	64.00	92%
4330	Indian Ruins	59	11:57	64.00	92%
4340	Riverside	59	12:14	64.00	92%
4350	Conifer Hill	59	12:13	64.00	92%
4360	Justice Center	58	12:13	64.00	91%
4470	Little Narrows	53	13:36	64.00	83%
4490	Apple Valley	53	13:16	64.00	83%
4510	Pinewood Springs	53	12:33	64.00	83%
4520	Eagle Ridge	56	13:05	64.00	88%
4530	Winiger Ridge	52	13:03	64.00	81%
4560	Lyons Diversion NSV	49	14:59	64.00	77%
4570	St. Antons	50	13:22	64.00	78%
4710	Ward C-1	54	12:17	64.00	84%
4730	Sugarloaf	51	12:55	64.00	80%
4750	Louisville Lake	50	13:37	64.00	78%
4770	Cal-Wood Ranch	55	12:50	64.00	86%
4790	Button Rock	52	13:30	64.00	81%
4810	Shanahan Ridge	58	12:13	64.00	91%
4820	Doudy Draw	43	13:05	64.00	67%
4830	SBC @ San Souci	43	12:20	64.00	67%
4840	SBC@S Boulder Ditch	58	12:13	64.00	91%

Rain Event Performance			Reports Received	Analyze Rain Sensors										
	Systemwide Avg	Total Tips	6356											
	82%	Data Loss	7880											
			19.34%											
Rain Sensor	Perf	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcvd	Expect	Miss	Holdoff		
1350	44%	9	4	1	1	0	0	1	15	34	9	0		
2310	47%	22	1	1	3	0	0	1	27	58	12	0		
540	48%	23	3	3	0	0	0	1	29	61	9	0		
1300	48%	10	1	0	0	0	0	1	11	23	1	0		
1920	53%	19	1	1	0	0	0	1	21	40	3	0		
840	56%	30	0	1	1	0	0	1	32	57	5	0		
1050	56%	23	4	0	0	0	0	1	27	48	4	0		
1800	57%	32	6	0	0	0	1	1	39	69	11	0		
1060	59%	32	1	0	0	0	0	1	33	56	1	0		
610	59%	24	1	1	0	0	0	1	26	44	3	0		
510	60%	40	3	2	0	0	0	1	45	75	7	0		
150	61%	38	12	2	1	0	0	1	53	87	19	0		
1400	61%	20	5	0	0	0	0	1	25	41	5	0		
860	61%	41	6	0	0	0	0	1	47	77	6	1		
700	63%	41	3	1	0	0	0	1	45	72	5	0		
1040	63%	33	2	0	0	0	0	1	35	56	2	0		
520	63%	34	4	1	0	0	0	1	39	62	6	0		
1310	63%	23	3	0	0	0	0	1	26	41	3	0		
2350	64%	22	3	3	0	2	0	0	30	47	17	0		
1010	64%	35	1	0	0	0	0	1	36	56	1	0		
650	65%	37	2	2	0	0	0	1	41	63	6	0		
530	65%	27	3	0	0	0	0	1	30	46	3	0		
1420	66%	32	1	0	0	0	0	1	33	50	1	0		
850	66%	44	5	0	0	0	0	2	49	74	5	0		
830	66%	39	11	1	1	1	0	1	53	80	20	0		
1320	67%	27	1	0	0	0	0	1	28	42	1	0		
1710	67%	25	3	1	1	0	0	1	30	45	8	0		
1360	67%	31	2	0	0	0	0	1	33	49	2	0		
420	68%	49	6	0	0	0	0	1	55	81	6	0		
800	68%	48	5	0	0	0	0	1	53	78	5	0		
2710	68%	25	3	0	0	0	0	1	28	41	3	1		
2320	69%	40	2	0	0	0	0	1	42	61	2	0		
1000	70%	30	2	0	0	0	0	1	32	46	2	0		
1660	70%	34	2	1	0	0	0	1	37	53	4	1		
1480	70%	44	5	0	0	0	0	1	49	70	5	1		
1700	70%	27	1	0	0	0	0	1	28	40	1	0		
1720	71%	44	4	0	0	0	0	1	48	68	4	0		
400	71%	59	4	1	0	0	0	1	64	90	6	0		
720	71%	57	6	1	0	0	0	1	64	90	8	0		
500	71%	57	5	0	0	0	0	1	62	87	5	0		
1520	73%	14	1	0	0	0	1	0	16	22	6	0		
1810	73%	57	7	0	0	0	0	1	64	88	7	0		
1340	74%	28	3	0	0	0	0	1	31	42	3	0		
600	74%	20	0	0	0	0	0	1	20	27	0	0		
210	74%	29	3	0	0	0	0	1	32	43	3	0		
1330	74%	61	5	1	0	0	0	1	67	90	7	0		
1460	75%	65	3	0	0	0	0	1	68	91	3	2		
820	75%	56	9	1	0	1	0	1	67	89	15	0		
330	76%	54	8	1	0	0	0	1	63	83	10	0		
1640	76%	16	2	0	0	1	0	0	19	25	6	0		
620	77%	25	4	0	0	0	1	0	30	39	9	0		
300	78%	31	1	0	0	0	0	1	32	41	1	0		
310	79%	63	7	0	1	0	0	1	71	90	10	0		
4010	79%	26	7	1	0	0	0	0	34	43	9	0		
1030	79%	19	3	0	1	0	0	0	23	29	6	0		
320	79%	24	2	0	0	0	1	0	27	34	7	0		
810	79%	50	4	2	1	1	0	0	58	73	15	0		
2370	79%	30	1	0	0	0	0	1	31	39	1	0		
1530	80%	19	0	0	0	0	1	0	20	25	5	0		
1620	81%	26	2	0	0	0	1	0	29	36	7	0		
870	81%	64	11	4	0	0	0	0	79	98	19	2		
1200	81%	33	8	1	0	0	0	0	42	52	10	0		
4790	81%	16	5	0	0	0	0	0	21	26	5	0		
1370	81%	44	3	0	0	0	0	1	47	58	3	0		
4730	81%	34	4	0	0	0	1	0	39	48	9	0		
4820	82%	25	7	0	0	0	0	0	32	39	7	0		
1440	84%	65	9	1	0	1	0	0	76	91	15	2		
640	84%	49	2	0	0	0	0	1	51	61	2	0		
100	84%	44	2	0	0	0	0	1	46	55	2	0		
2280	84%	45	7	0	1	0	0	0	53	63	10	12		
2730	84%	23	3	1	0	0	0	0	27	32	5	0		
120	85%	48	2	0	0	0	0	1	50	59	2	0		

440	85%	48	8	1	0	0	0	0	57	67	10	0
2810	85%	61	5	2	1	0	0	0	69	81	12	0
4250	85%	19	4	0	0	0	0	0	23	27	4	0
710	85%	39	8	0	0	0	0	0	47	55	8	0
220	86%	67	1	1	0	0	0	1	69	80	3	1
200	87%	58	0	0	0	0	0	1	58	67	0	0
4180	87%	35	4	1	0	0	0	0	40	46	6	0
630	87%	82	5	0	0	0	0	1	87	100	5	0
2330	87%	41	5	1	0	0	0	0	47	54	7	1
2840	88%	52	4	0	0	1	0	0	57	65	8	0
760	88%	59	4	1	1	0	0	0	65	74	9	0
4060	88%	25	4	0	0	0	0	0	29	33	4	0
4710	88%	50	8	0	0	0	0	0	58	66	8	0
4030	88%	32	5	0	0	0	0	0	37	42	5	0
730	88%	49	2	1	1	0	0	0	53	60	7	0
110	88%	65	2	1	0	0	1	0	69	78	9	0
1100	89%	27	4	0	0	0	0	0	31	35	4	0
2820	89%	56	5	0	1	0	0	0	62	70	8	0
750	89%	35	5	0	0	0	0	0	40	45	5	0
4840	89%	51	5	1	0	0	0	0	57	64	7	1
4170	89%	22	3	0	0	0	0	0	25	28	3	0
4200	89%	37	5	0	0	0	0	0	42	47	5	0
2360	89%	30	4	0	0	0	0	0	34	38	4	0
4830	89%	46	4	1	0	0	0	0	51	57	6	0
2240	90%	40	5	0	0	0	0	0	45	50	5	1
4130	90%	50	2	2	0	0	0	0	54	60	6	0
4470	90%	16	2	0	0	0	0	0	18	20	2	0
4220	90%	50	6	0	0	0	0	0	56	62	6	0
4240	90%	25	3	0	0	0	0	0	28	31	3	0
4080	90%	35	2	1	0	0	0	0	38	42	4	0
4570	91%	35	4	0	0	0	0	0	39	43	4	0
900	91%	45	3	1	0	0	0	0	49	54	5	0
4050	91%	28	3	0	0	0	0	0	31	34	3	0
4810	91%	38	4	0	0	0	0	0	42	46	4	0
4150	91%	39	4	0	0	0	0	0	43	47	4	0
2750	92%	31	1	1	0	0	0	0	33	36	3	0
4090	92%	40	4	0	0	0	0	0	44	48	4	0
4360	92%	40	4	0	0	0	0	0	44	48	4	0
1500	93%	84	2	0	0	0	1	0	87	94	7	0
4290	93%	23	2	0	0	0	0	0	25	27	2	0
4490	93%	23	2	0	0	0	0	0	25	27	2	0
4350	93%	36	1	1	0	0	0	0	38	41	3	0
4750	93%	24	2	0	0	0	0	0	26	28	2	0
4770	93%	36	3	0	0	0	0	0	39	42	3	0
4070	93%	52	4	0	0	0	0	0	56	60	4	0
4190	93%	39	3	0	0	0	0	0	42	45	3	0
2270	93%	54	2	1	0	0	0	0	57	61	4	1
2250	94%	71	0	1	1	0	0	0	73	78	5	1
410	94%	30	0	1	0	0	0	0	31	33	2	0
4020	94%	45	1	1	0	0	0	0	47	50	3	0
4310	94%	32	2	0	0	0	0	0	34	36	2	0
4510	95%	33	2	0	0	0	0	0	35	37	2	0
4520	95%	34	2	0	0	0	0	0	36	38	2	0
740	95%	55	3	0	0	0	0	0	58	61	3	1
1600	96%	21	1	0	0	0	0	0	22	23	1	0
2340	96%	42	2	0	0	0	0	0	44	46	2	1
1110	96%	22	1	0	0	0	0	0	23	24	1	0
1540	96%	51	2	0	0	0	0	0	53	55	2	0
2190	96%	77	3	0	0	0	0	0	80	83	3	2
2230	96%	52	2	0	0	0	0	0	54	56	2	1
4260	97%	55	2	0	0	0	0	0	57	59	2	0
4330	97%	32	1	0	0	0	0	0	33	34	1	0
4270	97%	36	1	0	0	0	0	0	37	38	1	0
4300	98%	39	1	0	0	0	0	0	40	41	1	0
4040	98%	41	1	0	0	0	0	0	42	43	1	0
4110	98%	41	1	0	0	0	0	0	42	43	1	0
140	98%	46	1	0	0	0	0	0	47	48	1	0
4160	98%	48	1	0	0	0	0	0	49	50	1	0
4100	98%	52	1	0	0	0	0	0	53	54	1	0
2260	99%	69	1	0	0	0	0	0	70	71	1	0
1900	100%	50	0	0	0	0	0	0	50	50	0	0
2210	100%	88	8	4	1	1	0	10	102	102	23	28
4140	100%	2	0	0	0	0	0	0	2	2	0	0
4230	100%	30	0	0	0	0	0	0	30	30	0	0
4340	100%	39	0	0	0	0	0	0	39	39	0	0
4530	100%	42	0	0	0	0	0	0	42	42	0	0
TOTAL		5774	484	62	18	9	9	68	6356	7880	743	61

